Cracks in the Glass: the emergence of a new image typology from the spatio-temporal schisms of the 'filmic' Virtual Reality panorama

Abstract

Virtual Reality Panoramas have fascinated me for some time; their interactive nature affording a spectatorial engagement not evident within other forms of painting or digital imagery. This interactivity is not generally linear as is evident in animation or film, nor is the engagement with the image reduced to the physical or visual border of the image, as its limit is never visible to the viewer in its entirety. Further, the time taken to interact and navigate across the Virtual Reality panorama's surface is not reflected or recorded within the observed image. The procedural construction of the Virtual Reality panorama creates an a-temporal image event that denies the durée of its own index and creation. This is particularly evident in the cinematic experiments conducted by Jeffrey Shaw in the 1990s that 'spatialised' time and image through the fusion of the formal typology of the Panorama together with the cinematic moving-image, creating a new kind of image technology. The incorporation of the space enclosed by the panorama's drum, into the conception and execution of the cinematic event, reveals an interesting conceptual paradox. Space and time infinitely and autonomously repeat upon each other as the linear trajectory of the singular cinematic shot is interrupted by a 'time schism' on the surface of the panorama. This paper explores what this conceptual paradox means to the evolution of emerging image-technologies and how Shaw's 'mixed-reality' installation reveals a wholly new image typology that presents techniques and concepts though which to record, interrogate, and represent time and space in Architecture.

MAPPING THE TEMPORAL SCHISM

In 2000 Jeffrey Shaw exhibited an interactive computer-graphic video installation entitled *Place Ruhr* in the Industrial Museum of Dortmund, Germany.[1] Through the exploration of the relation between image and space, and the exploitation of the interactive capacity of emerging image-technologies such as the Virtual Reality panorama, Shaw created a complex network of spatial experience. *Place Ruhr* is ostensibly an interactive virtual environment that consists of eleven panorama-based filmic events, or pano-filmic events. Each of the eleven pano-filmic events were mediated and controlled through the innovative manipulation of "architectures/systems that respond to the exigencies of the particular project, as well as the perceptual conditions of these new works that the virtual environments are."[2] In order to navigate within the *Place Rhur* environment, the observer stands upon a motorised rotating platform in the centre of the cylindrical space. From this position the observer is able to control the direction of the image-projector, directly tracking the direction of their gaze through space. As the observer rotates the viewing platform, through the mediation of a computer joystick, the viewing aperture into the pano-filmic event moves respectively, mimicking the changing direction of the observer's gaze. In order to increase their field of view the observer rotates the platform, and thus reveals more of the panorama. The projector pans respective to the observer's bodily direction and altered gaze, providing "a constellation of theatrical cinematic events that the viewer can visit and examine in whatever order he and she chooses."[3] As a result, the pano-filmic event is never presented to the observer in its entirety, rather, it unfolds over time as the observer's gaze, and with it the projected moving-image, gradually reveals the complete pano-filmic event.

Shaw inverts the conventions of the painted panoramas of the nineteenth-century, projecting an interactive cinematic event onto the surface of the panoramic screen.[4] The projection of the panoramic image onto the internal surface of the panoramic cylinder encircles the observer within the very pictorial space of the panorama itself. This construction of the subject/object relation technique draws directly upon the organisational conventions of the nineteenth-century panorama in achieving its effect, making the immaterial characteristics of virtual reality manifest in physical form in the installation's own physicality.[5] The conventional static nature of the panorama's pictorial surface is brought to life, animated by the projected moving images that dance across the panoramic screen. Through the clever manipulation of this projection technique *Place Ruhr* brings together the fictive space of virtual reality together with the real space of the

observer: “it is a modular interactive theatre where two kinds of spaces are conjoined - the cinematically represented spaces, and the spaces of the virtual environment in which these cinematic events are geographically located.”[6] In one of the eleven panoramic event spaces, depicting the Villa Hügel in Essen, “[t]wo children suddenly appear out of nowhere, a boy dressed as a cowboy chasing a girl dressed as a Red Indian. They run between the picnickers, then vanish into the background again.”[7] Within this scene the cinematic event appears to loop upon itself as the children's figurative presence on the screen dramatically dissolves. For a fraction of a second, no visual trace remains echoing the presence of the children in the scene. The observer is left only with a supposition as to the children’s location. Only the extrusion of the children’s trajectory in logical correlation to the uninterrupted space through which they appeared to travel, offers any clues as to the children’s disappearance. As suddenly as they appeared to vanish from the scene, they reappear, however now out of apparent temporal alignment with their own motion, and out of geographic sync with their previous movement paths across the scene. The combination of cinematic conventions together with the physical typology of the panorama result in a typological and temporal paradox: a schism in space and time. The fact that the moving image has been captured through a single panning shot, in order to represent the panning motion of the observer’s vision, and then projected upon the Euclidean geometry of mimetic infinity [the cylinder] results in a cinematic and temporal loop. As the camera passes through a full 360º of horizontal rotation a seam is revealed between the temporality of the scene, and that of the observer.

In effect, the observer is viewing across not only the surface of the panoramic screen, but also across multiple potential temporalities and narrative timelines. The observer thus directs the image-event as their gaze effectively generates the image witnessed. Only the viewer’s gaze scans across the surface of the panoramic screen as there is never any corporeal movement afforded by the image-apparatus. As a result, the installation is more closely associated with the gaze of the VR Panorama’s techniques of spectatorial subjugation then the nineteenth-century panorama which allowed a certain amount of bodily movement in space. In *Place Ruhr* the observer’s gaze is able to pan across the panorama’s surface, whilst inversely in the VR panorama, the observer’s gaze remains fixed I place: In this instance it is the panorama’s surface itself that appears to pan about the observer.

As has been outlined, there are some fundamental differences between the conventional nineteenth-century panorama, the VR panorama, and Shaw's application of these conventions in the execution of *Place Ruhr.* It is these very differences that reveal the potential revelation of Shaw's approach. In order to analyse and understand the implications of the 'time schism' that Shaw's installation reveals, this paper will explore how we conceptually understand the relation between movement and time in the nineteenth-century 'painterly' panorama, Shaw's pano-cinematic hybrid, and the VR panorama today.

WHAT IS A VIRTUAL REALITY PANORAMA?

The proliferation of digital cameras since the mid 1990s,[8] and the rapid development of associated software for the extraction and manipulation of the subsequent digital images, has resulted in the increased popularity of the Virtual Reality panorama, both for domestic and commercial applications. If you visit any real estate or tourism-based website on the Internet today, the VR panorama is used as a means of describing and representing space. The VR panorama achieves its effect by centralising the viewer within an immersive, image-rich virtual space.[9] Several different geometries are used to construct the VR panorama, however the most prolific and widely used type in the domestic market today is the cylindrically based VR panorama, which is also the most typologically familiar to the nineteenth-century panorama.[10] The observer is centralised within this encircling virtual cylinder, panning and zooming into the virtual space separating the observer from the cylinder's surface in order to interrogate the visual information provided by the panoramic image.

The projection of digital images upon the surface of a cylindrical drum is not necessarily a new concept. The nineteenth-century not only bore witness to the 'painterly' panorama made famous by Robert Barker and his patenting of the panoramic concept and technique, *La Nature á Coup d' Œil*,[11] but also the projected panoramas of Charles A. Chase, and the 'photorama' designed by the Lumiere Brothers. The translation of a series of images together into one unified image presented a difficult technical challenge. Chase projected sixteen photographic slides upon a panoramic surface, however, the overlap between each of the projected images created visual distortions that prevented the creation of a visually correct 'all-encompassing' image. The Lumiere Brothers' 'photorama' attempted to reconcile the technical deficiencies of Chase's projection system through a single optical cylinder that amalgamated the panorama's image

fragments together.[12] However, neither system was commercially viable. Both Chase and the Lumiere Brothers attempted to abolish the perception of each of the individual component images from the totality of the panoramic whole, but with little success. Subsequent attempts to achieve similar levels of panoramic immersion such as Abel E. Glance's 'Magnascope' of the late 1920s, Fred Waller's 'Cinerama' projection system of the late 1950s, or Walt Disney's own proprietary 'Circorama' system, all failed to achieve popular appeal.[13] Barker's was the only technique to offer a form of artistic mediation that allowed the separate image fragments to be successfully merged through spherical correction.[14]

It seems almost natural that the fascination with wide screen formatted images, particularly in the later half of the twentieth-century, has lead to the reemergence in popularity of the panoramic image. It drew a direct lineage to the wide-screen format of panoramic Landscape painting and the cinematic image which similarly maintained a primarily horizontal format.[15] It is no coincidence that we refer today to composition generally in terms of its proportional format, portrait [vertical format] or landscape [horizontal format].[16] Through this new format, photographers attempted to record images of scenes that previously could not be captured within one photographic shot, due primarily to optical limitations in the camera's lens technology. The dramatic warping of the image that occurs in the periphery of the photograph when photographing scenes within a short focal length, was one of many factors that stimulated a search for an alternative means to photo-record and re-present visually rich and immersive scenes. The horizontal format of the image afforded a seemingly limitless horizontal frame that was in some ways more emblematic of the vastness and horizontal nature of the scenes that were actually experienced.

The standardisation of this technology by many of the primary pre-digital photographic camera and filmmakers in the 1990s further allowed for the new medium to infiltrate the homes of the general populous.[17] It was just as easy to photograph dramatic landscape scenes, and then have those landscape photos developed at your local chemist or department store, in either the standard photographic print formats or the new panoramic formats.[18] The comparative ease through which the general populous adopted this new image format and its associated technologies allowed for the relative ease in transition between analogue and digital print formats. The advent of digital photography lead to the conception of software that was capable of stitching together a large number of individual

digital photographs into a unified panoramic image: Not a VR panorama yet, but one that already heralded many of the procedural techniques and technologies that its successor would use in the mid-to-late 1990s.

THE NINETEENTH-CENTURY PANORAMA

As has been initially discussed, the VR panorama draws, both spatially and conceptually, upon the 'painterly' panoramas of the nineteenth-century.[19] Robert Barker's conception and patent of the *La Nature á Coup d' Œil* in 1787 attempted to immerse the observer in a sense of 'being-there-ness' that was not available in Landscape painting, and other forms of representation of the period. According to Bernard Comment, the all-encompassing nature of the panorama was appropriated as a symbolic form, that expressed the "perceptual and representational fantasies that befitted … the troubled times" of the nineteenth-century Industrial Revolution.[20] It embodied the rapidly changing character of the emerging modernised city and presented fantasy landscapes of exotic 'far-off' lands, and propaganda images of significant historic and militaristic nation-forming events.[21] The era of tourism emerged in the nineteenth-century parallel to the development of the panorama, finding "in the panorama, with its longing for faraway places, a versatile ally",[22] as a direct result becoming a populist "economic surrogate for travel."[23] As Richard Altick has observed;

> What cost a couple of hundred pounds a half a year half a century ago, now costs a shilling and a quarter of an hour. Throwing out of the old account the innumerable miseries of travel, the insolence of public functionaries, the roguery of innkeepers, the visitations of banditti charged to the muzzle with sabre, pistol, and scapulary, and the rascality of the custom-house officers, who plunder, passport in hand, the indescribable désagréments of Italian cookery, and the insufferable annoyances of that epitome of abomination, and Italian bed.[24]

The nineteenth-century panorama however was not celebrated and embraced openly by all: it was primarily denigrated for its spectatorial and theatrical effect. Historical records outlining the various reactions to the panorama's effect recall accounts of men recoiling in fear, women emotionally overcome by the affect of the illusion, and in the most extreme of cases, fainting. Barker's inaugural panorama at the Leicester Square Rotunda, *A View of the Fleet at Spithead* [1793], depicted the ensuing chaos of a capsizing ship from the Russian Fleet. *Chamber's Journal of Popular Literature* in 1860 recalls the dramatic effect of the Panorama's verisimilitude; "It happened that a gentleman visiting the exhibition of

the picture was accompanied by a Newfoundland dog, and the animal, on seeing this part of the painting, sprang over the hand-rail, to rescue the drowning men."[25] The illusion further amplified by the camouflaging of the viewing platform, from which the fleet was viewed, to appear as the afterdeck of a frigate within the heart of the fleet itself.[26] The panoramic medium was so new and unfamiliar to the viewing public that the general populous found it difficult to differentiate picture from reality, so accurate was the representation presented.

The effect of the panoramic painting was not limited to specific demographic status of English society. In the *Panorama of Granada*, exhibited in 1853, a view of the Alhambra Palace in Granada was represented, richly adorned with oleander. William Chambers observed the effectiveness of the panorama;

> [A] royal lady who was visiting the exhibition, and who was attended by a gentleman connected with the establishment, requested him to oblige her with a branch of the oleander to take away with her, so complete was the deception produced in her mind.[27]

The success of such panoramic illusions further exemplified by the emotive reaction witnessed of the Duke of Wellington when visiting Robert Burford's panorama, *The Battle of Sobraon* in 1846. From the Duke's viewing position, conceptualised as that of the 'commander in chief's' view of the battlefield, Wellington "became intensely excited, and seemed to chafe against the barriers which restrained him from the field he so distinctly realised."[28] In the anecdotal evidence presented as to the success of the Panorama in presenting immersive illusion, the fundamental intent of the panorama was "to imagine a haptic dimension, to have the impression that it is possible to touch the cardboard soldiers or intervene in the battle, [this] is the core of the concept of immersion."[29]

As a result of this discussion, it is clear that the nineteenth-century panorama and the VR panorama share more historical and conceptual lineage than that of their cylindrical shape. They have both been used as vehicles through which to reconstruct the observing subject, and as Jonathan Crary reminds us, to historically and discursively reconstruct vision itself.[30] The effectiveness of the panorama's effective and affective capacity was based upon its ability to maximise the conventions and traditions of *trompe l'œil* painting into one immersive spectatorial event. One of the primary criticisms levelled at the nineteenth-century panorama was its conceptual association with indexicality, and not representation. This issue also underpins much of the current debate surrounding the

application of the VR panorama as an art form. It too has been denied status as an art form due to its reliance upon the indexical nature of photography, and not the representational narrative of the artist. It is this very reliance upon the indexical nature of photography that Jeffrey Shaw has manipulated in his *Place* installations, embedding existential nuances "often cruelly lacking in the digital universe."[31] This paper will expand upon this concept further in order to chart the implications of Shaw's 'expanded' cinema installations, and its capacity to en-frame and express its own procedural and conceptual temporality.

TEMPORALITY AND THE ANALOGUE PHOTOGRAPH

The time taken to record a photograph is limited to the time taken for light to pass through the aperture of the camera's lens, and onto the face of the film within the camera's carcass. The resulting mechanical exposure of the film's light sensitive surface directly to sunlight creates a "chemical process occurring in the same spatial and temporal vicinity as the exert it records."[32] It simultaneously infuses the durational effect of the camera's aperture upon the temporality of the scene being recorded. The longer the period of time that the camera's aperture is left open, the greater procedural duration that is absorbed into the image. "[Photography] records a moment of reality as it actually appeared"[33] and was often considered a 'mirror' of the world.[34] The advent of the digital camera has lead to a dramatic change in the way in which the photographic image is created, however the duration of the image's creation has ultimately not changed. Although the media of the camera has been irreconcilably altered, the facture of the surface has been replaced with varying levels of pixel density.[35] The longer the digital camera's lens is left open, the greater the amount of temporal information that is recorded and infused into the subsequent digital image. Although the process where by the image itself is recorded has fundamentally changed, from chemical [analogue] to digital, the optical physics that underpins the lens technology has remained relatively the same.

The photograph has historically been heralded for its ability to indexically record a scene,[36] however photographers discovered that the chemical process could be manipulated in order to alter the 'truth' of the image, both in the act of taking the photograph and through the act of chemically developing the film and resulting photographic print in the dark room. Similarly, and more familiar for the digital image user, the advent of the digital image afforded a higher degree of malleability and alterability then ever before.[37] The potential apotropaic power of the photographic image therefore –

for both the analogue and digital photograph – lies in the ability of the "copy drawing on the character and power of the original, to the point whereby the representation may even assume that character and that power [of the original]."[38] However, as Walter Benjamin reminds us, the authenticity or "presence of the original" image is corroded by the mechanical production processes made possible by the Industrial Revolution,[39] and as a result the inability of the image artefact to substantiate its own authentic identity. The image's basis as an indexical record, regardless of its inability to repel unscrupulous reconfiguration, still provided a level of unsurpassed verisimilitude underpinning its appropriation in cinema and the VR panorama.

With the recent emergence of new image technologies, such as the VR panoramic image and VR image objects,[40] the VR panorama's reliance upon photography as its sole constructional media reveals the spatial and temporal contradictions between its constituent elements. The panorama's procedural creation, the systematic blending of a series of photographs to form the all-encompassing panoramic image, removes any trace of the embedded temporalities of any one of the individual photographic events. The procedural creation of the panorama fundamentally alters the relationship between each of the individual image's duration, and the duration of the image's projection, resulting in a un-authentic temporal compression. The temporal inconsistencies that exist between the duration of each shot in the VR panorama are widely acknowledged as a negative aspect of the image technology, deliberately removed and proactively excluded from the resulting a-temporal image. The very conceptual intent of the proprietary software that is used to compose and construct the VR panorama is to systematically destroy the temporal 'truth' of the resulting panoramic image. How might this rich embedded lattice of procedural temporality offer a potentially rereading of the VR panorama?

CONCLUSION

So how might this understanding of the indexical characteristics of the nineteenth-century 'painterly' panorama, and Shaw's *mixed-reality* application of the pano-filmic *mixed-reality* have agency upon how we understand the implications of the VR panorama today? If we reconsider the interpenetration between the image fragments of the VR panorama and redefine their relationship, not in terms of their spatial displacement, but in terms of their temporal derivation, then we begin to offer opportunities to challenge the dogmatic repression of the image's own temporal 'truth', and make them as a direct result, the subject of the work, and not the object of its denigration and destruction. As Karin

Costelloe observes of interpenetration, “the parts depend for their qualitative character upon their connection with the whole of the rest of the process.”[41] In film, this concept of interpenetration has been applied in order to understand the capacity of vision to appropriate multiple images through the perceived ‘persistence of vision’[42] in order to observe illusionary movement: movement not actually within the images themselves, but as a result of the mechanism of their conceptual interrelation to the movie as a whole. In revisiting Shaw’s *Place Rhur* installation, this interpenetration is evident in the interrelation between the ‘spatialised’ picture plane of the panorama typology and the projected moving image. Shaw wields the seemingly contradictory mediums of the panorama and the moving-image in order to “draw attention to the material specificity distinguishing each one,” and to “foreground the ‘framing function’ of the embodied viewer-participant.” In Shaw’s work the panorama’s geometric character is manifest in physical form, however in the VR panorama the perception of its geometric construction is illusionary. The disavowal of time through its systematic destruction is not a repression of time, but rather a compression that awaits release and emancipation in order to transform into a wholly new image technology. The prevailing obsession with verisimilitude and indexicality lead to the death of the nineteenth-century panorama, replaced by other forms of popular visual entertainment that were able to present more spectacular theatrical effects. The evolution of the VR panoramic medium must objectively learn from the past, and in particular the weaknesses of its own cultural heritage. As this paper has attempted to reveal, the application of indexical mediums such as the photograph in the VR panorama are able to transcend the conceptual and representational limitations of its inherent indexicality. Through the applied typological opposition to its own temporal linearity, the VR panorama is now able to celebrate the temporality frozen within its image in unison with the *dureé* of its creation. When we view through cracked glass into the world beyond its surface we are offered a refracted, redefined view of the world. So to *Place Rhur* presents us with a wholly new image typology that transfigures space and time into a new *mixed-reality* image that celebrates its own spatio-temporal essence. As Karin Costelloe observes, “the nature of what comes after only finds its explanation by reference to what came before.”[43]

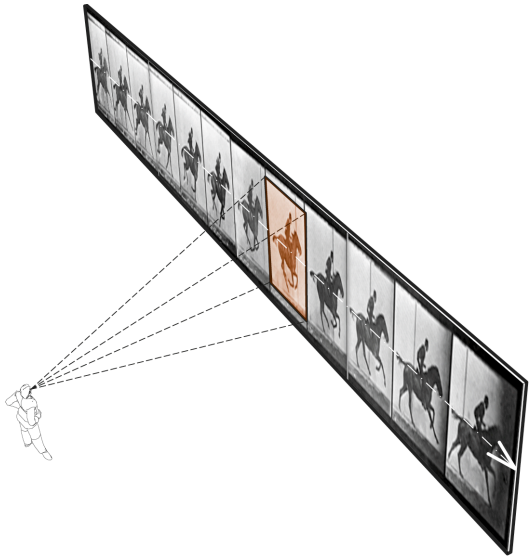


Fig.01
Linearity of Conventional Cinema illustrating the conventional view of one film cell at a time.

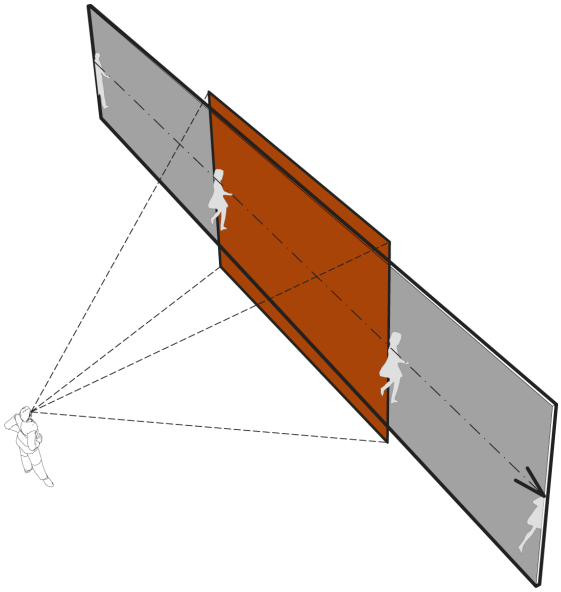
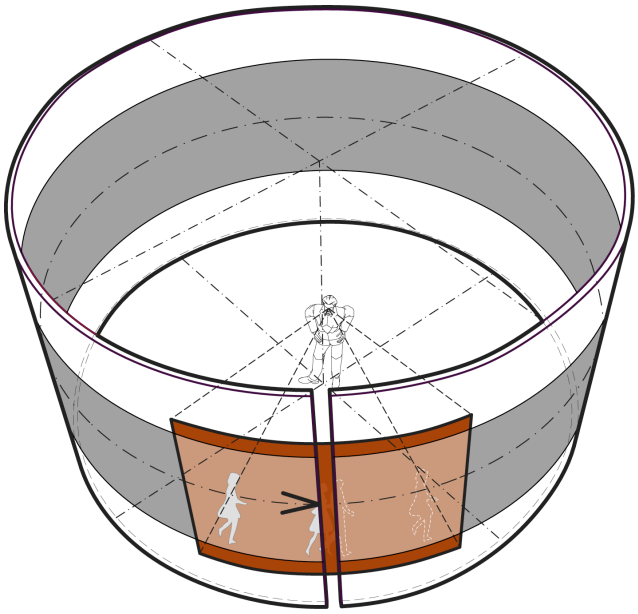


Fig.02
'Time Schism' unfolded

Fig.03 [below]
Cylindrical VR panorama interactivity diagram illustrating the panning of the drum around the observer, and their tele-present location at the drum's centre.



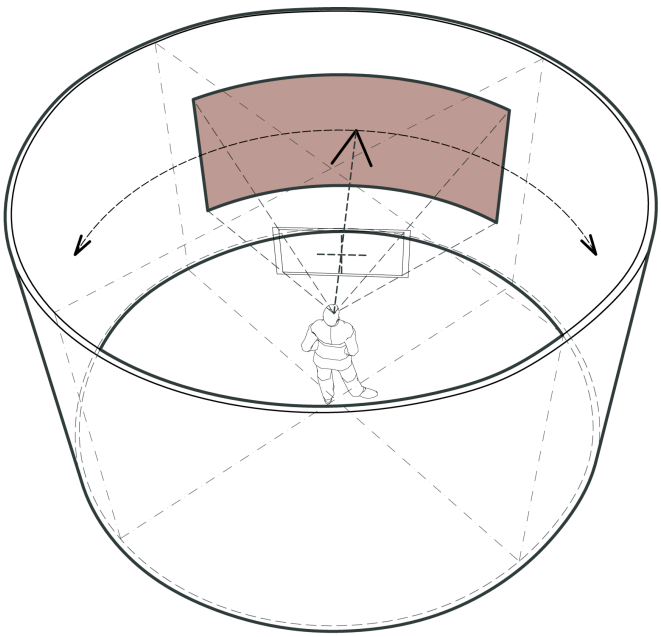


Fig.04 [above]
Diagram illustrating the 'time Schism' in Shaw's *Place Rhur.* Children are illustrated disappearing across the schism/seam in the panorama's surface.

[1] *Place Rhur* is one iteration in a series of *Place* installations explored by Jeffrey Shaw since 1995 that have explored differing contextual conditions through which to execute the *Place* concept. See Jeffrey Shaw, *Jeffrey Shaw – a User's Manual : From Expanded Cinema to Virtual Reality*: Hatje Cantz, 1997.
[2] Jeffrey Shaw & Peter Weibel, *Future Cinema : The Cinematic Imaginary after Film* (Cambridge, Mass: Zentrum für Kunst und Medientechnologie Karlsruhe & MIT, 2003) 381.
[3] Jeffrey Shaw, "Place Ruhr," (Ruhr: 2000).
[4] Mark B. N. Hansen, *New Philosophy for a New Media* (Cambridge, Mass.: MIT Press, 2004), 118.
[5] Anne-Marie Duguet, "Jeffrey Shaw: From Expanded Cinema to Virtual Reality." *Jeffrey Shaw - a user's manual* (ZKM Karlsruhe, Germany: Cantz Verlag, 1997) 21-58.
[6] Shaw, "Place Ruhr."
[7] Shaw, Peter Weibel & Jeffrey. *Future Cinema : The Cinematic Imaginary after Film*, 386.
[8] The first mass-produced digital cameras for the general consumer market were the Apple QuickTake 100 camera in 1994, the Kodak DC40 camera in 1995, the Casio QV-11 in late 1995, and Sony's Cyber-Shot Digital Still Camera in 1996.
[9] [2005]. Conversations with Ken Turkowski whom was a founding member of the Apple Advanced Technology Group that developed the Quicktime VR concept at Apple Computer in the 80's.
[10] There are actually three different types of geometries used in the construction of the VR panorama. The cylindrical, the cubic, and the spherical. For a discussion concerning the conceptual and technical differences between these three VR panorama typologies, see Christopher Brisbin, "Spatial Transfiguration: Anamorphic *Mixed-Reality* in the Virtual Reality Panorama", in Proceedings for the Panorama to Paradise: Scopic Regimes in Architectural and Urban History and Theory, SAHANZ, 24th Society of Architectural Historians Australia and New Zealand Conference, Sydney 2007.
[11] Robert Barker, "La Nature Á Coup D' Oeil," (England: The Repertory of Arts and Manufactures, 1787).
[12] Stephan Oetterman, *The Panorama: History of a Mass Medium* (New York: MIT Press, 1997), 85.
[13] Ibid., 88-90.
[14] Robert Barker's system involved drawing the image fragments that we would be combined to create the panorama in a spherical format. When combined together in-the-round the distortions that would normally result are minimised. For a detailed account of Barker's technical process for the reconciliation of spherical distortion, see William and Robert Chambers, "Panoramas," *Chamber's Journal of Popular Literature* 316 (1860).
[15] Scott McQuire, *Maximum Vision: Large-Format and Special-Venue Cinema*, *Screen Industry, Culture and Policy Research Studies* (Sydney: Australian Film Commission, 1999).
[16] Paul Duro, *The Rhetoric of the Frame : Essays on the Boundaries of the Artwork*, *Cambridge Studies in New Art History and Criticism.* (Cambridge [England] ; New York, NY, USA: Cambridge University Press, 1996).
[17] Here I am specifically referring to the kinds of photographic equipment that the general public could, and would buy off the shelf, not the semi-professional and professional equipment that allowed for the photographing of 180º and 360º scenes.
[18] See the *Advantix* disposable panoramic cameras
[19] Heinrich Wolfflin, *Renaissance and baroque* (Ithaca, N.Y.: Cornell University Press, 1966), 29-37. Here I am drawing direct reference to Wolfflin's use of the 'painterly style' in order to differentiate between different codes and conventions that effect the 'elusiveness of the eye' to adequately determine formal or geometric characteristics in the nineteenth-century panorama. This concept separates the painted panoramas of the nineteenth-century from the photographic image based Virtual Reality panoramas of the twentieth and twenty-first-centuries.
[20] Bernard Comment, *The Panorama*, trans. Anne-Marie Glasheen (London: Reaktion Books Ltd, 1999), 8.
[21] Ibid.
[22] Oliver Grau, *Virtual Art: From Illusion to Immersion* (Cambridge, Massachusetts: MIT Press, 2003), 69.
[23] Silvia Bordini, "Paesaggi E Panorami: Immagine E Immaginazione Del Viaggio Nella Cultura Visiva Dell'ottocento," in *Richerche Di Storia Dell'arte* (Rome: La Nuove Italian Scientifica, 1982), 27, Grau, *Virtual Art: From Illusion to Immersion*, 69.

[24] *Blackwoods Magazine*, no. 15 (1824): 472, Richard Altick, *The Shows of London: A Panoramic History of Exhibitions 1600-1862* (Cambridge, MA: Belknap Press, 1978). Cited In Altick, R. (1978). The Shows of London: A Panoramic History of Exhibitions 1600-1862. Cambridge, MA, Belknap Press.
[25] William and Robert Chambers, "Panoramas," *Chamber's Journal of Popular Literature* 316 (1860): 34. See also George Richard Corner, "The Panorama: With Memoirs of Its Inventor Robert Barker and His Son, the Late Henry Aston Barker," *Art Journal* 3 (1857): 47.
[26] Comment, *The Panorama*, 24.
[27] Chambers, "Panoramas," 34.
[28] Ibid.: 35.
[29] Oliver Grau, "Into the Belly of the Image: Historical Aspects of Virtual Reality," *Leonardo* 32, no. 5 (1999): 126.
[30] Jonathan Crarey, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge, Massachusetts: OCTOBER books - MIT Press, 1990).
[31] Duguet, "Jeffrey Shaw: From Expanded Cinema to Virtual Reality," 41.
[32] Norman Bryson, "The Gaze and the Glance," in *Vision and Painting: The Logic of the Gaze* (London: Macmillan, 1983), 89.
[33] Martin Jay, *Downcast Eyes : The Denigration of Vision in Twentieth-Century French Thought* (Berkeley, Calif.: University of California Press, 1993), 126.
[34] Richard Rudisill, "Mirror Image : The Influence of the Daguerreotype on American Society" (Originally presented as the author's thesis, University of Minnesota, 1967., University of New Mexico Press,, 1971).
[35] In referring to facture, I am referring to Bryson's description of the spatial and temporal form of the pigment on the painting's surface, and in the terms of this paper's argument, the way in which we might consider the digital image's pixel as a digital form facture. Bryson, Norman. "The Gaze in the Expanded Field." In *Vision and Visuality*, edited by Hal Foster, 87-114. Washington: Bay Press, 1988.
[36] Rosalind E. Krauss, *The Originality of the Avant-Garde and Other Modernist Myths* (Cambridge, Mass.: MIT Press, 1985).
[37] Charles S. Peirce and Justus Bucher, *The Philosophy of Peirce : Selected Writings*, *International Library of Psychology, Philosophy and Scientific Method.* (London: Routledge & Kegan Paul, 1940).
[38] Michael Taussig, *Mimesis and Alterity* (New York: Routledge, 1993), xiii. For a discussion of 'apotropia' see Ernst Kitzinger, "The Cult of Images in the Age before Iconoclasm," *Dumbarton Oaks Papers* 8 (1954): 119., Richard Krautheimer, "Introduction to An "Iconography of Mediaeval Architecture"," *Journal of the Warburg and Courtauld Institutes* V (1942).
[39] Walter Benjamin, "The Work of Art in the Age of Mechanical Reproduction," in *Illuminations* (New York: Schocken Books, 1968), 220.
[40] 'VR image objects' are an interesting variation to the VR panorama. Patented by Apple computers, the 'image object' inverts the subject-position of the observer from looking outwards from themselves into a scene, to looking inward onto an object. The object therefore becomes three-dimensionalised in pictorial space and can be rotated and zoomed into, depending on the resolution of the photographs used to document the 'image-object'. This technique in part popularised by 'time-slicing' which is used in film to freeze an object in time, that can subsequently be rotated in space. See Ndalianis, Angela. "The Frenzy of the Visible: Spectacle and Motion in the Era of the Digital." Review of Reviewed Item. *senses of cinema*, no. 3 (2000), http://www.sensesofcinema.com/contents/00/3/matrix.html.
[41] Ibid.
[42] Joseph & Anderson Anderson, Barbara, "The Myth of Persistence of Vision Revisited," *Journal of Film and Video* 45, no. 1 (Spring 1993), Joseph & Fisher Anderson, Barbara, "The Myth of Persistence of Vision," *Journal of the University Film Association* XXX:4 (Fall 1978).
[43] Karin Costelloe, "What Bergson Means by Interpenetration," *Proceedings of the Artistotlean Society* 13 (1912): 149.